CLAIMS

What is claimed is:

5   1.   A method of gauging entities in an image comprising the steps of:

constructing a model data structure;

identifying a set of gauge entities in said model;

automatically configuring sub-models according to the stability of features in said sub-models for computing position of each of said gauge entities;

10   locating said sub-models in said image;

computing positions of each of said gauge entities by reference to locations of located sub-models; and

determining the spatial relationship between said gauge entities.

15   2.   The method according to claim 1 further comprising the step of assessing said spatial relationships for compliance with preselected tolerances.

3.   The method according to Claim 1 wherein the step of automatically configuring sub-models further comprises the steps of:

20   defining a set of regions for each gauge entity;

assessing each region for stable reference features;

selecting a best region for each gauge entity; and

training a sub-model representing each feature that exceeds a predetermined stability threshold within each of said best regions.

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4.   The method according to claim 3 wherein the step of assessing each region further comprises the steps of:

segmenting each region into contiguous portions containing features;

mathematically assessing the stability of each portion; and

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assessing the stability of each region according to the stability of portions within its respective region that exceed a predetermined stability threshold.

5. The method according to claim 4 wherein the step of mathematically assessing the stability of each portion further comprises the steps of:

selecting degrees of freedom required to compute the spatial relationship of particular gauge entities with respect to the respective feature; and

invoking an alignment tool to compute the stability of each feature for determining the spatial relationship of said gauge entity with respect to said respective feature and said degrees of freedom.

6. The method according to claim 4 wherein the step of mathematically assessing the stability of each portion further comprises the steps of:

constructing a portion stability matrix for each portion;

computing a condition number for said matrix; and

determining the stability of each portion according to said condition number.

7. The method according to claim 1 wherein the step of computing positions of each of said gauge entities further comprises a step of determining locations of said gauge entities by interpolation.

8. The method according to claim 7 wherein said interpolation is performed with reference to said located sub-models.

9. An apparatus for gauging entities in an image comprising:

an image acquisition device; and

an image analysis system in communication with said image acquisition device wherein said image analysis system operates on an acquired image to determine spatial relationships between gauge entities by:

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automatically configuring sub-models according to stability of features in said sub-models for computing position of each of said gauge entities;

locating sub-models in said image; and

computing positions of said gauge entities by reference to locations of located sub-models.

10. The apparatus according to claim 9 wherein said image analysis system assesses said spatial relationships for compliance with preselected tolerances.

11. An apparatus according to claim 9 wherein said image analysis system automatically configures sub-models by:

defining a set of regions for each gauge entity;

assessing each region for stable reference features;

selecting a best region for each gauge entity; and

training a sub-model representing each feature that exceeds a predetermined stability threshold within each of said best regions.

12. An apparatus according to claim 11 wherein said image analysis system assesses each region by:

segmenting each region into contiguous portions containing features;

mathematically assessing the stability of each portion; and

assessing the stability of each region according to the stability of portions within its respective region that exceeds a predetermined stability threshold.

13. An apparatus according to claim 12 wherein said image analysis system mathematically asses the stability of each portion by:

selecting degrees of freedom required to compute the spatial relationship of particular gauge entities with respect to the respective feature; and

invoking an alignment tool to compute the stability of each feature for determining the spatial relationship of said gauge entity with respect to said respective feature and said degrees of freedom.

14. The apparatus according to claim 12 wherein said image analysis system mathematically assesses the stability of each portion by:

constructing a portion stability matrix for each portion;

computing a condition number for said matrix; and

determining the stability of each portion according to said condition number.

15. An apparatus for gauging entities in an image comprising:

means for acquiring an image; and

means for analyzing an said image in communication with said means for acquiring an image wherein said means for analyzing said image operates on an acquired image to determine spatial relationships between gauge entities by:

automatically configuring sub-models according to stability of features in said sub-models for computing position of each of said gauge entities;

locating sub-models in said image; and

computing positions of said gauge entities by reference to locations of located sub-models.

16. An apparatus according to claim 15 wherein said means for analyzing said image assesses each region by:

segmenting each region into contiguous portions containing features;

mathematically assessing the stability of each portion; and

assessing the stability of each region according to the stability of portions within its respective region that exceeds a predetermined stability threshold.

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17.   An apparatus according to claim 16 wherein said means for analyzing said image mathematically asses the stability of each portion by:

selecting degrees of freedom required to compute the spatial relationship of particular gauge entities with respect to the respective feature; and

5   invoking an alignment tool to compute the stability of each feature for determining the spatial relationship of said gauge entity with respect to said respective feature and said degrees of freedom.

18.   The apparatus according to claim 16 wherein said means for analyzing said image
10   mathematically assesses the stability of each portion by:

constructing a portion stability matrix for each portion;

computing a condition number for said matrix; and

determining the stability of each portion according to said condition number.

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